Changing trends: A brief history of the US consumption of energy, water, food, beverages and tobacco

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Abstract. Can an historic analysis of consumption patterns of different commodities in the U.S. shed light on the consumption of energy? Can a review of past policies to reduce or change consumption patterns provide insight or guidance in developing new policies for reducing energy use? In order to better understand energy conservation policies, we take a brief look at the history in the US of consumption and curtailment of different commodities, including energy, raw materials, water, beverages and tobacco. Per capita consumption of all of these commodities has fluctuated over the past 100 years. With few exceptions, policies to reduce their consumption, e.g., prohibition, exhortation, regulation, taxation, have had little effect on consumption. Periods of curtailment, e.g., wartime, natural disasters and other shortages, have led to reductions in consumption, which were generally short lived. In some cases, reductions in consumption resulted in less service. In other cases, reduction in consumption led to changes in the services provided. By reviewing the history of consumption and curtailment we identify strategies that have the potential for promoting the long-term conservation of energy.

"*The future, according to some scientists, will be exactly like the past, only far more expensive*."
-John Sladek

Introduction

Danish physicist, Niels Bohr, noted that "Prediction is very difficult, especially about the future." Following this Nobel laureate's advice, we will focus our attention in this paper on historical trends in consumption, rather than future predictions. We start by looking at historical consumption data and ask questions about the social and political forces that have led to increases and decreases in consumption. We look at the consumption of energy, water, raw materials, and also at beverages, tobacco as other products that have been the subject of social and political experiments in promotion, curtailment and conservation. As in our previous work, we raise more questions than we answer, but we feel the approach of asking questions to be fruitful in giving us insights in where to focus our attention.

Patterns of Consumption—Historic Trends

Electricity & Gas

We'll start with the familiar graph of historic US primary energy consumption from 1949 to 2001 (Figure 1). In 1949, U.S. energy use per person stood at 215 million Btu. The rate of consumption generally increased until the oil price shocks of the mid-1970s and early 1980s caused the pattern to reverse for a few years. After slight increases in the 1990s, the rate fell 4 percent from 2000 to 2001 (EIA Table 1.5).

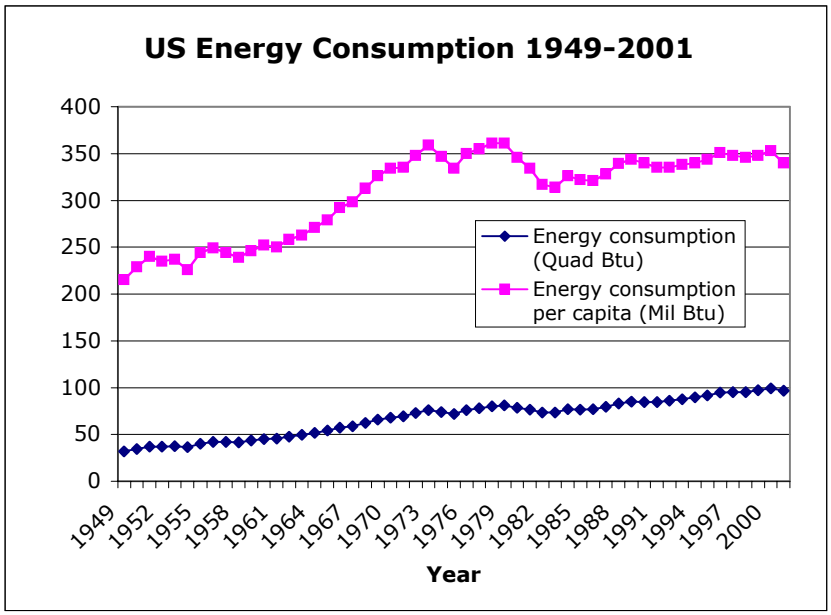

Figure 1. US primary energy consumption,
total and per capita consumption from 1949 to 2001.

Such a figure invites several questions: Did per capita energy use increased from 1949 to 1973 due to bigger houses and cars, more appliances, more appliance usage, more energy intensive activities, air conditioning, etc.? Does this leveling off reflect a structural shift in the economy from manufacturing towards service?

If we look at the historic trend in residential energy use per capita we see part of the story in Figure 2 (EIA 2003).

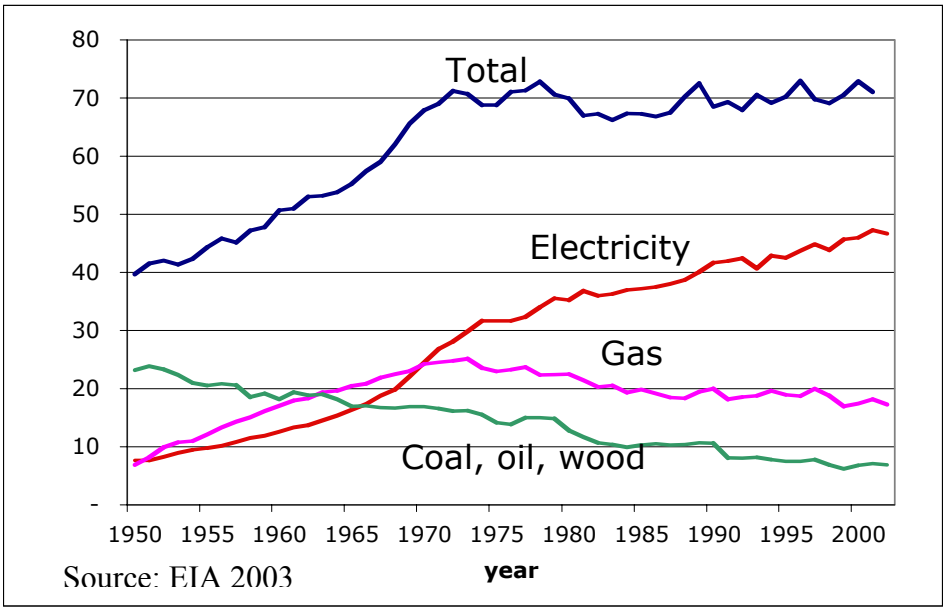

Figure 2. US residential energy use per capita, total, electricity (source), gas and other.

While the residential total per capita energy use shows the same leveling off as the US total energy use, the residential gas use has declined since 1970 and the electricity use has continued to increase. The increase could be due to greater air conditioning use (both in volume of space conditioned as well as hours of usage) as well as other appliance usage, switching from gas to electric (heat pumps, water heaters), or other factors (demographic shifts).

If we look at the increase in house size over this time, as well as the increase in appliance saturation and usage, we can start to see the drivers behind the increase. Figure 3 shows that average new house floor area has increased from 983 ft^2 in 1950 to 2266 ft^2 in 2000, more than doubling. As household size has decreased, the floor area per capita has increased, from 286 ft^2 per capita in 1950 to 847 ft^2 per capita in 2000.

The decrease in gas use is probably due to reductions in space heating from improvements in the thermal envelope. Higher insulation levels in the walls and ceilings, better windows and more air tight construction would all lead to lower levels of gas used for space heating. Savings in gas water heating, gas stoves and other gas appliances may not be as significant.

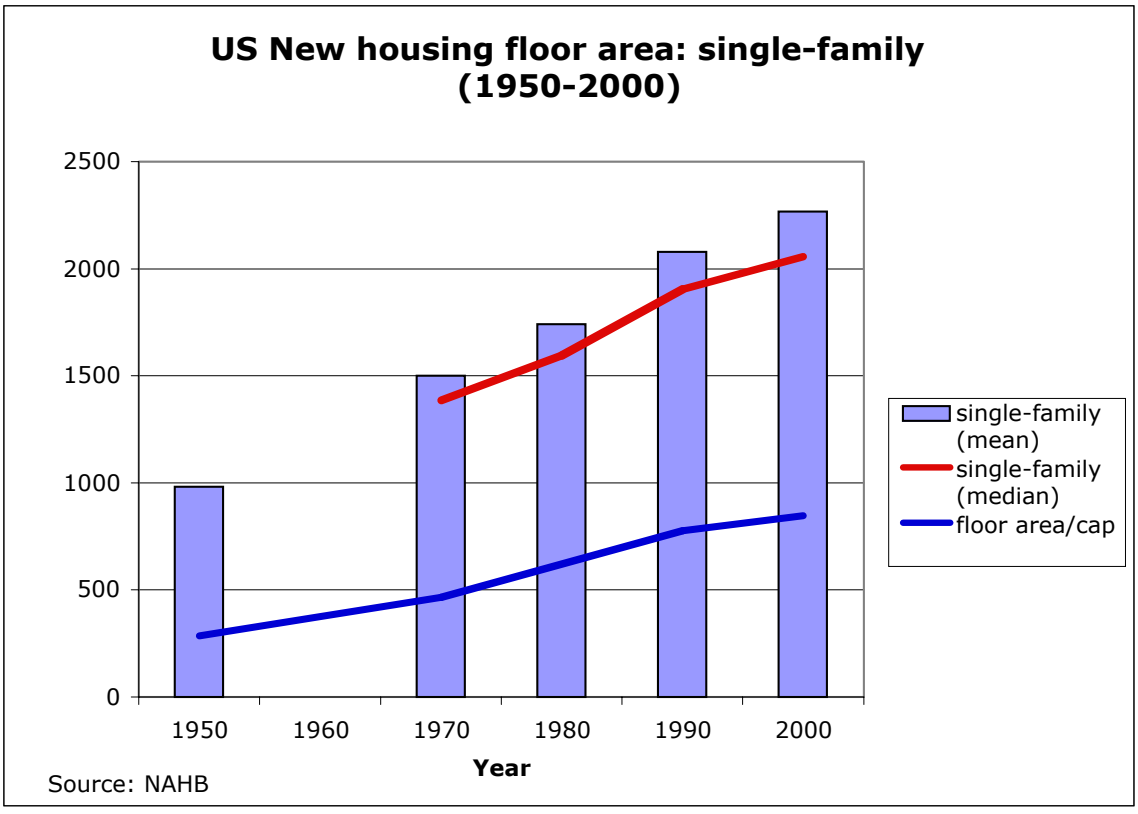

Figure 3. US new single-family housing floor area, mean, median and per capita (1950-2000). Source NAHB, US Census

As new houses get bigger, we are not only conditioning more space, but also filling them with more appliances and equipment. The market share of energy-efficient appliances may be increasing, but as we have seen, so is per capita consumption. A question that we raise is whether people are increasing their purchase of appliances and energy using equipment at the same rate as improvements in energy efficiency? If this were true, then we could expect to see a relatively flat level of expenditure for energy over time. Economists have argued that the "take-back" effect, if it exists, is quite small (citations; see Herring 1997 for a good discussion), but if it is not take-back as conventionally framed, what accounts for the increase rather than decrease in energy consumption?

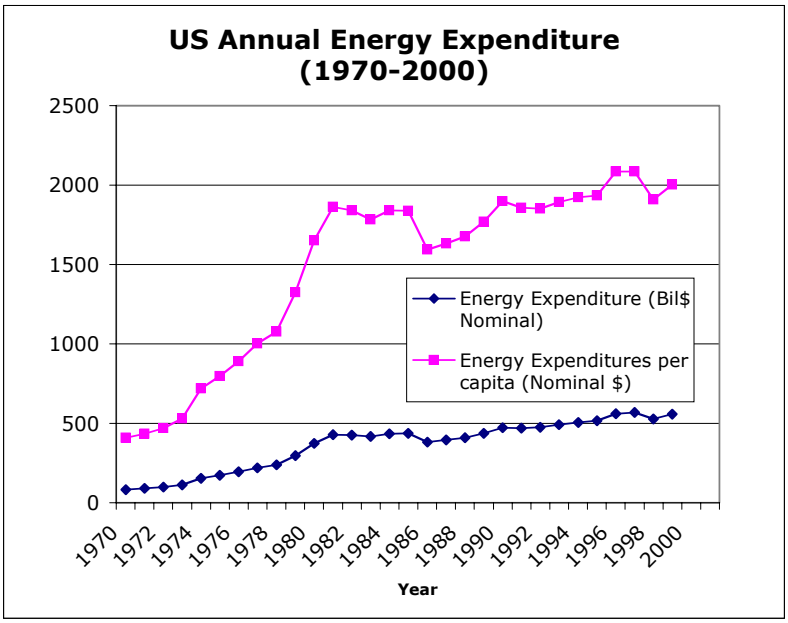

Figure 4 US Annual Energy Expenditure 1970-2000.

The data in Figure 4 suggest that per capita energy expenditure rose quickly from 1970-1980, and then has leveled off in the past 20 years with a slight increase. [Need to break out residential and look at real rather than nominal data, and to see how prices have changed over this period!]

Gasoline

The familiar trend data for gasoline include miles driven per vehicle and fuel rate (miles per gallon) Figure 5.

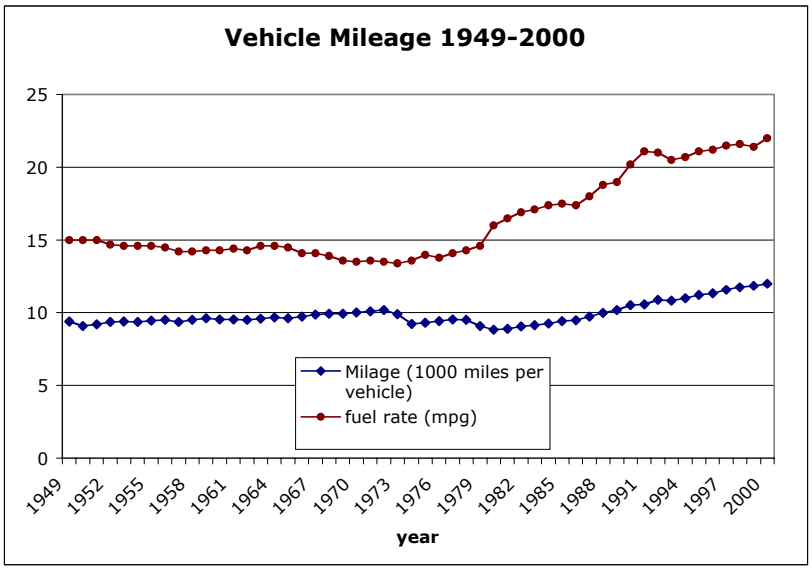

Figure 5. Vehicle mileage and fuel efficiency 1949-2000.

The findings here are that fuel efficiency was remarkable flat at 10 miles per gallon from 1950 until the mid 60s and after actually decreasing from for a few years increased to meet the new standards. Vehicle mileage was also remarkably flat during this historic period and started increasing in the 1980s. When we look at the 50-year trend in gasoline prices (real), they have remained remarkable flat, around $1.50 per gallon, with the exception of the price spikes in the early 1980s due to the oil embargoes.

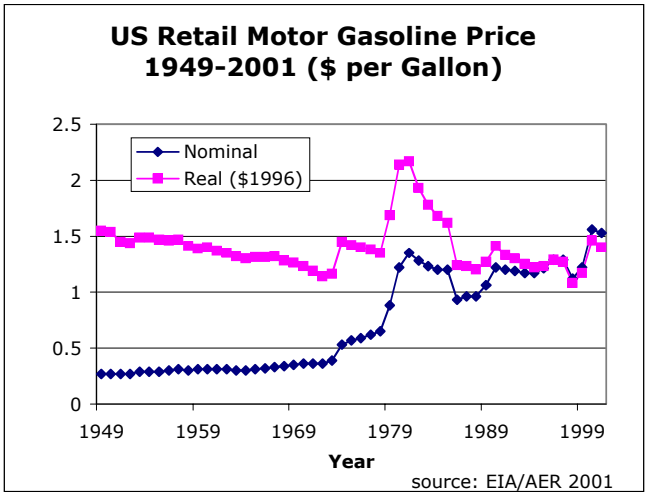

Figure 6. US retail motor gasoline price 1949-2001 $ per gallon (EIA 2002)

[Discussion of how price, policy, advertising, etc. has effected automobile fuel use.]

Water

Household water consumption is an interesting parallel to household energy consumption in that the monthly expenditures are similar in much of the US. Like energy, water is metered (generally) and households pay a monthly or bi-monthly bill. And similar to energy, most households have no idea of how much water they use and how they use it. [could include figure of household water use by end-use]

From the beginning of this century to 1970, urban per capita water use increased steadily, as illustrated by Figure 7, which charts increases in per capita water use in the San Francisco Bay area (California 1993). Since 1970, however, the per capita use has been fluctuating but no longer shows a steady increase in most areas of the State. Large reductions in per-capita water use are pronounced during drought years when aggressive short-term conservation and rationing programs are in effect. In the long term, permanent water conservation programs and other factors have begun to reduce overall per capita water use in some areas.

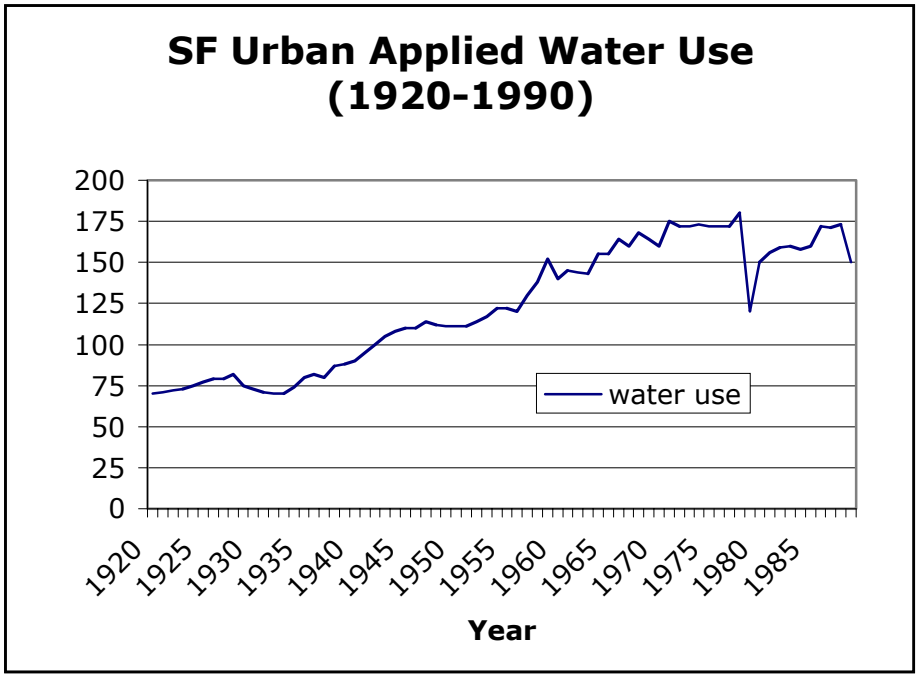

Figure 7. Urban Per Capita Water Use, San Francisco Bay Area, 1920-1990
(source: California 1993)

Other factors tend to raise per capita unit use rates, thus making it difficult to analyze trends. Climatic variations affect water use significantly from one year to the next. In the long term, fewer people per household, increases in household income, and population growth in warmer inland areas have tended to counteract the effects of multifamily housing and conservation, which drive per capita water use downward.

Water conservation efforts, like those in energy have well-documented take back effects. As an example, low-flow showerheads required users to take longer showers to rinse soap and shampoo, and the finer mist led to greater heat loss between the showerhead and the skin, requiring hotter water temperatures. One reaction to the “efficient” low-flow shower head has

been the introduction of two pressure-equalized, water saving heads on one extension, allowing two people to shower as efficiently as one—or one person to shower more comfortably and effectively in half the time. [Brookstone – Catalog of Hard to Find Tools – "Two Heads Are Better Than One—Double Your Shower's Efficiency!"]

Figure 8. Deluxe model low-flow showerhead.

And for those hedonists who want to enjoy a full-coverage shower, there are also oversized showerheads that release 2.5 gallons per minute (Figure 8)

The effort to conserve urban water has paralleled the energy conservation/efficiency activities of the past 20 years, with demand-side management programs, education, rebates, incentives, etc., following much the same pattern as the energy utilities and municipalities. One significant difference is the lack of overall data on water use and end use. Another difference is the lower expectations for conservation. The 1990 projection for the San Francisco Hydrologic Region urban residential water use was a 7% reduction by 2020, from 106 gallons per day per capita (gpcd) to 98 gpcd, due to best management practices. A 7% reduction over 30 years is a pretty modest goal—much less stringent then federal energy standards, e.g., 30% reduction in 25 years. But water is relatively cheap—in California we pay an average of $1.80 for a thousand gallons of water, compared to $1.80 for <u>one</u> gallon of gasoline.

<u>Food</u>

Evidence from various sources suggests that Americans now consume, on overage, more total food, more snacks, bigger portions of food, and more calories than they did 30 years ago (Putnam 1999). A variety of factors are responsible for the changes in US food consumption patterns in the last 30 years, including changes in relative food process, increases in real disposable income, and more food assistance for the poor. New products, particularly more convenient ones, along with more imports, growth in the away-from-home food sector, expanded advertising programs and changes in food enrichment standards and fortification policy. Socio-demographic trends also driving food choices include smaller households, more two-earner households, more single-parent households, an aging population and increased ethnic diversity. New dietary guidelines designed to help people make food choices to promote health and prevent disease, improved nutrition labeling and increased awareness of nutrition also influence marketing and consumption trends (Putnam 1999).

Demand for food in the aggregate is not very responsive to price changes, because there is little room for substitution between food and non-food items. However, demand for individual foods is more responsive to prices as consumers substitute among alternative food commodities.

Internationally, Americans spend the least on food in relation to per capita consumption, 7% of personal consumption expenditure for food eaten at home. This figure compares with 10% in Canada and 11% in the UK and over 50% for India or Philippines (Putnam 1999.)

The level of food energy in the US food supply increased from 3300 calories per capita per day in 1970 to 3900 calories in 2000. This 15% increase reflects higher levels of all three food groups, carbohydrates (grains & sweeteners), fats and proteins (grains, poultry & cheese). Total calories in 1909 is estimated at 3400 kilocalories/day, so the level was flat for several decades before the recent increase.

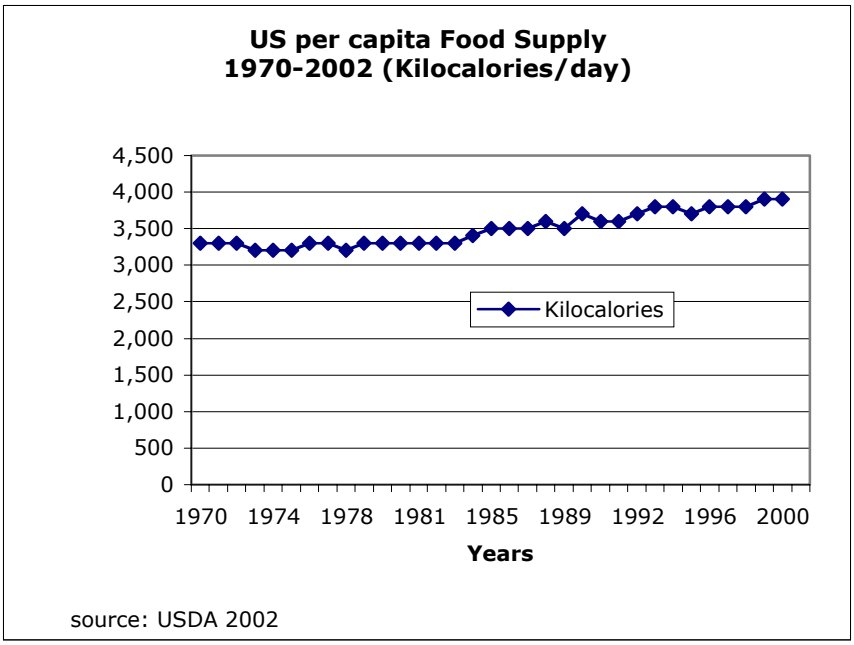

Figure 9. US per capita food supply.

Beverages

Beverages provide an example of how government subsidies, marketing and other forces change patterns and trend of consumption. Consumption of beverages has changed dramatically in the US over the past 40 years (Figure 10). In 1945, Americans drank more than four times as much milk as carbonated soft drinks; in 1997, they downed nearly two and a half times more soda than milk. Milk consumption has decreased, alcohol consumption has leveled off and decreased slightly and soft drinks and bottled water have increased dramatically. The reasons for the increase in soft drink consumption have been advertising and heavy subsidies to the producers of corn syrup, which surpassed cane and beet sugar for the first time in 1985 (Putnam 1999). Apparently the "Got Milk" advertising, despite their clever sales' pitches, has not been able to

reverse the decline in milk sales.

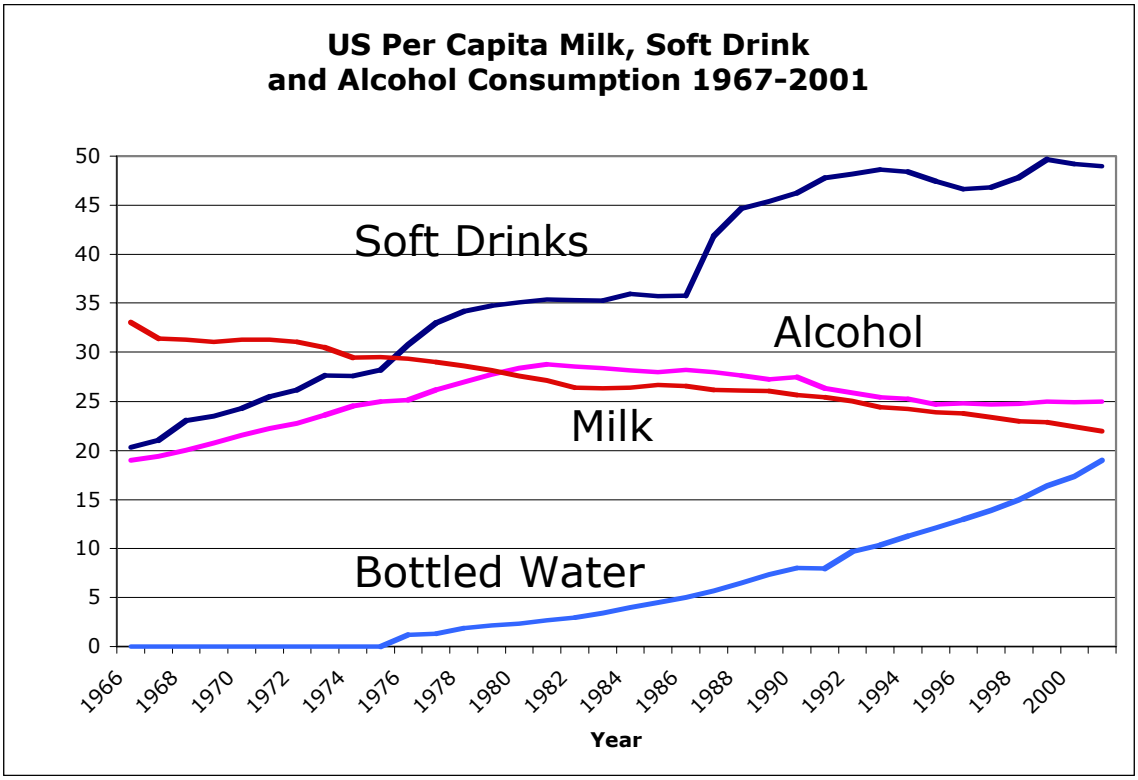

Figure 10. US Beverage consumption 1967-2001

Tobacco

One wouldn't generally compare the consumption of a commodity like tobacco (a drug) with a commodity like energy, but if we are looking for examples of where government intervention seems to have led to a reduction in use, there are few cases as dramatic as cigarettes. Cigarette consumption increased dramatically in the first half of the 20th century, particularly during the two world wars. The turning point came in 1964 following the US Surgeon general's report on smoking (Figure 11).

Since 1990, though, the decline in the percent of adults who smoke has slowed. In 2000, 25 percent of men and 21 percent of women were smokers. If we are interested in how to break people of their "energy habit", it is worth noting that changing behavior is far more difficult than establishing "good" behavior initially. This is a special challenge for energy consumption, both because it is a continuous process, linked to myriad other choices but almost always indirect, and because energy consumption is to a good extent built in to our things, many of which do not change quickly.

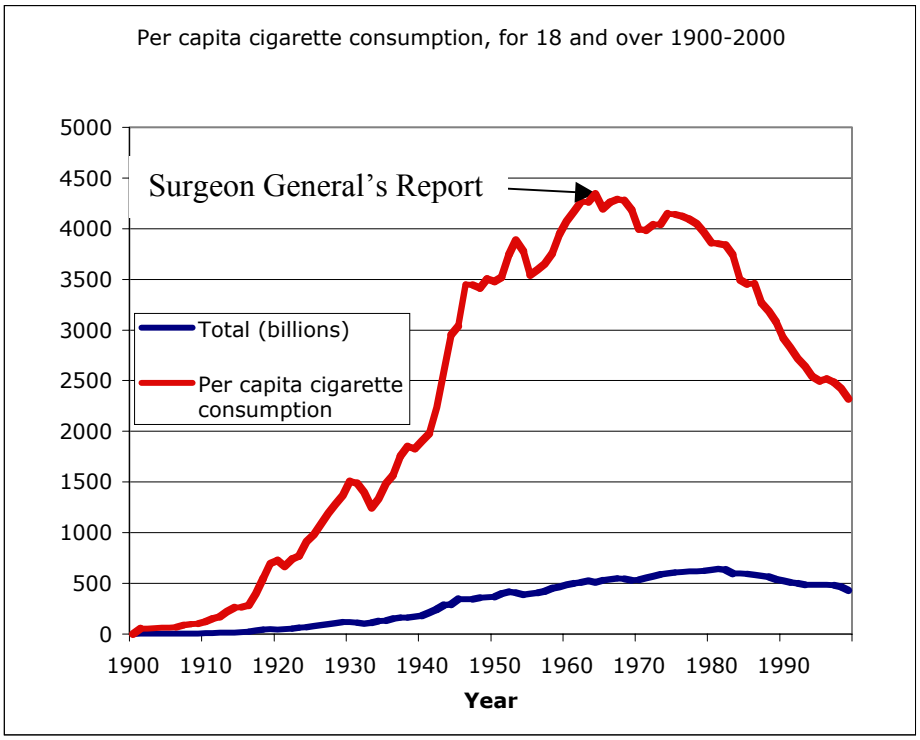

Figure 11 Total and per capita cigarette consumption 1900-2000.

Why Does Consumption Go Up?

If we want to be able to formulate policies that focus on reducing consumption of energy—or any good—it may help to understand the basis for why people consume in the first place. Basic consumption is needed for survival—shelter, fuel, food and clothing. But the levels of consumption seen by contemporary culture vastly exceed any level for assuring that basic needs are met. Social scientists have written on the multiple reasons for why people consume beyond what they need for survival—e.g., for status, for pleasure, for display, convenience, marketing, etc. (Cooper 1998; Wilk 2002). A recurring phenomenon noted by several observes of the contemporary scene is that wants and desires become necessities (Wilk citing Illich 1977).

Juliet Schor in her work, "The Overspent American" 1998, has made several observations on the motivations for contemporary American consumer culture.

> "In the old days, our neighbors set the standard for what we had to have. Today a person is more likely to be making comparisons with .. people whose incomes are significantly higher."
>
> "We are more likely to identify with the characters on "Friends" than with our real friends."

> "Consumer satisfaction depends less on what a person has in an absolute sense than on socially formed aspirations and expectations"

Schor also traces the changes from a set of early American values that held, thrift, sufficiency and modest consumption which changes in the wave of mass prosperity. "Spending, even spending to excess, was extolled as good for the ego, if not for the soul. Consumerism became the new, therapeutic belief system. Religious, legal, and folk impediments to consumption declined markedly. Most insidious of all, aggressive spending was made patriotic. It spread the wealth, we were told, creating jobs for the unemployed as well as profits for American industry." (Schor 1998). Cross notes that consumerism is a relatively new phenomenon (Cross 2000).

Anthropologist Willett Kempton notes that from an environmental perspective, a problem with consumption to display social status is that status is always relative, generating an unending spiral of increasing consumption, display and recomparison (Kempton 2003).

When Does Consumption Go Down?

Is the general pattern that we always consume more and more of everything, or are their cases when consumption drops? And in those cases, is it the direct result of policies, or shifts in societal and economic forces? One of the goals of American energy policy is to increase efficiency, not to decrease energy consumption, although decreased consumption is implied in carbon-emissions reductions objectives. Efficiency achievements are typically stated in terms of avoided energy consumption, calculated as energy savings relative to a (necessarily) abstract baseline. But energy policy generally addresses efficiency on an end use by end use, technology by technology, rather than on a more aggregate (for example, societal) basis. In this sense, achieving absolute reductions in overall or per capita energy consumption *is not* the goal of energy policy. There is also a moral argument for reducing consumption, which we do not review here (Rudin 2002, others).

While policy makers and politicians may not care to admit it, there have always been numerous ways in which government influences the consumption of materials, favoring increases in some commodities while instituting practices that lead to decreases in others.
As a quick—but not exhaustive—review, here are several policies for reducing consumption, both mandatory measure and voluntary measures, using water conservation as a model (Renwick 1998).

<u>Mandatory policy measures</u>:

Rationing programs generally allocate a fixed quantity of water to households, based on some allocation criteria, and impose penalties for exceeding the allotment such as severe marginal price penalties.

Restrictions on water use constitute a more precise form of rationing. Use restrictions place constraints on when certain types of water use practices can occur, such as no washing down sidewalks or driveways, or bans on landscape irrigation during peak evapo-transpiration hours.

During the 1990-1991 drought, Santa Barbara banned nearly all forms of irrigation and hired "water police" to enforce the policy.

Compliance measures. The SF Water Department adopted a compliance affidavit program. Households were required to file an affidavit attesting that specific water-efficient devices were employed. Those that did not faced higher marginal prices.

Voluntary Measures

Information. Public information campaigns to alert households to shortages, to motivate more efficient water behavior, and to provide information on means to reduce usage.

Rebates. Subsidies to encourage adoption of water-efficient technologies, such as ultra low-flow toilets, horizontal-axis washing machines.

Retrofits. Distribution of free retrofit kits, including low-flow showerheads, tank displacement devices and dye tablets for leak detection.

Some economists would argue that these policies are unnecessary, if people paid the true cost of water [or energy], then these actions would not be needed. Economic theory also suggests that residential water demand should be price inelastic for three reasons: 1) there exists no close substitutes for water in most of its uses, 2) the amount of money spent on water is a relatively small share of the typical household budget, and 3) water is frequently demanded jointly with some other complementary good, e.g., clothes or dish washing (Bach 1980). And yet we see wide variation in household water consumption.

An interesting parallel with energy use is the observation that "The use of price as an allocation mechanism is constrained by the fact that water is generally regarded as a basic necessity, even as a right, not an economic good" (Berk et al., 1980 cited in Renwick, 1988). Policy makers are willing to talk about conservation of water, not just efficiency. Is this because water, unlike energy is a natural resource, not a manufactured good?

Another question raised in the conservation debate is whether reductions in consumption will wreak havoc with the economy? Schor (1998) presents a few scenarios to counter this assertion:

1. Hours and employment. If consumer spending slows, production will go down, but employment can be maintained if fewer people want jobs or work fewer hours. Buying less may mean working less. The driver for consuming less is to have more free time.

2. Savings and consumption. If people buy less, but don't work less, they will save more, which some economists think is a good thing. Other economists worry that if people save more, then businesses stop investing, which leads to recession and unemployment.

3. Growth and Productivity. Places like Netherlands and Denmark have relatively lower economic growth rates, where people have accepted less economic growth in exchange for more non-work (leisure) hours. A question we have about this scenario is whether reductions in energy

consumption in one area lead to increases in leisure time activities that are equally or more energy intensive?

This paper will not settle the debate on whether consumption should be lowered and if so, how. But we feel it is instructive to step back and take a long view at past trends in consumption, and to see when consumption of individuals commodities has increased and decreased. One important lesson has been that things do change over time, whether due to government intervention or social and economic forces. Perhaps the guiding insight we are left with is Lewis Mumford's observation that "Trends aren't destiny."

"The future will be better tomorrow." -Dan Quayle

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